

A TAXONOMIC AND DISTRIBUTIONAL STUDY OF THE SPECIES OF *PRODENIA* OCCURRING IN CALIFORNIA

(Lepidoptera: Phalaenidae)

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The bulk of the material presented in this paper was gathered in 1948 and 1949 in the course of investigations on the bionomics of the important crop pest *Prodenia praefica* Grote, the western yellow-striped armyworm, *P. praefica* and the closely allied *P. ornithogalli* Guenée, the yellow-striped armyworm, are the only species of *Prodenia* which occur in California. In the past a certain amount of confusion has existed as to the taxonomic and distributional relationships of the two species, and it is hoped that this paper will help to clarify this situation.

The genus *Prodenia* contains nine species, the majority of which occur in tropical and subtropical America. The species included in the genus in addition to *praefica* and *ornithogalli* are *rubrifusa* Hampson; *dolichos* (Fabricius); *pulchella* Herrich-Shaffer; *androgea* (Cramer); *litura* (Fabricius); *marima* Schaus; and *latifascia* Walker. Of these species only *praefica*, *ornithogalli*, *dolichos*, and *latifascia* have been recorded from the United States, the latter being a doubtful record. *P. litura* is the only species which occurs outside the western hemisphere. It is found widely distributed throughout the old world tropics and subtropics where it is of great economic importance on a variety of crops. It is not known to occur in the western hemisphere.

KEY TO THE CALIFORNIA SPECIES OF *PRODENIA*

1. Posterior wings dull, somewhat fuscous with distinct discal spots on ventral surfaces; forewings with apical fasciae inconspicuous; male clasper with relatively short thick uncus, ampullae short, truncate (Fig. 1C); mature larva with head capsule heavily reticulated (Fig. 1A).....*praefica* Grote.
Posterior wings semi-hyaline, discal spots absent; forewings with apical fasciae conspicuous; male clasper with relatively long slender uncus, ampullae slender finger-like (Fig. 1D); mature larva with head capsule faintly reticulated (Fig. 1B).....*ornithogalli* Guenée.

PRODENIA PRAEFICA Grote

Prodenia praefica Grote, 1875, Canad. Ent. 7:44; 1882, Check List Macrolepid. Amer. N. of Mex., Brookl. Ent. Soc., pg. 14; Smith, 1893, U. S. Nat. Mus. Bull. 44:170; Hampson, 1909, Cat. Lep. Br. Mus. 8:250 pl. 128,

fig. 20; Woodworth, 1911, Mon. Bull. St. Comm. Hort. Calif. 1(10):788; Barnes and McDunnough, 1917, Check List Lepid. Bor. Amer., pg. 67; Seitz, 1923, Macrolep. World div. 2 vol. 7:256, fig. 373; Barnes and Benjamin, 1924, Contr. Nat. Hist. Lep. N. Amer. 5(2):80-81; Crumb, 1927, Bull. Brookl. Ent. Soc. 22(1):43. 52 pl. 4a; Blanchard and Conger, 1932, Jour. Econ. Ent. 25(5):1059-1070; McDunnough, 1938, Mem. So. Calif. Acad. Sci. 1(1):96; McDunnough, 1943, Canad. Ent. 75(1):1. *Prodenia ornithogalli praefica*, Dyar, 1902, U. S. Nat. Mus. Bull. 52:123.

Female: Head, mottled with white, grey and black scales; antennae clothed with flat white or brown scales on anterior surfaces, posterior surfaces with fine short hairs only. Thorax concolorous with head except for some rufous scales. Forewing brownish or brownish grey in general coloration, marked with white, black, and bluish areas; median vein and its branches whitish at region of orbicular stigma, forming a conspicuous white patch with the orbicular; reniform stigma creamy white or brownish with a white margin; apical fascia narrow, inconspicuous, outer margin of wing marked by broken white and black lines, ciliae brown except at tips of main veins which are white. Ventral surface of forewing greyish white, moderately infuscated, a strong black spot in midcostal region; forewings about 40 to 46 mm. when spread. Posterior wings dull greyish white in aspect, dorsal surface faintly to strongly infuscated, a continuous or broken black line at margin, veins brownish black. Ventral surface dull whitish, speckled with black especially in costal region, clothed with coarse flat scales, a distinct black discal spot present. Legs greyish white with small black areas on tarsal segments. Abdomen greyish dorsally, venter dull white sparsely speckled with black, terminal segments heavily clothed with downy black scales, closely surrounded by long yellowish scales.

Male: Similar to female but usually more brightly colored with the bluish and brown areas of the forewing less somber, apical fasciae more conspicuous, posterior wings only weakly infuscated.

Adult variation: In addition to the typical adult specimens discussed above, a melanistic form also exists. This dark form is only encountered early in the year when moths are emerging from overwintering pupae. Specimens of both sexes are dark bluish grey in gross appearance with conspicuous white orbicular patches on the forewings. The head, abdomen and thorax are uniformly dark grey in color and contrast strongly with the buff color of these body regions in typical specimens. The posterior wings in both sexes are much darker than in the typical form.

Mature Larva: Smooth, meso and metathoracic segments and 7th and 8th abdominal segments slightly swollen, ground color of body reddish or greyish brown mottled with white. Head capsule, approximately 2.5 mm. in width, ground color brownish to brownish orange heavily reticulated with blackish or reddish markings, adfrontal sutures and areas yellowish white forming a conspicuous inverted V. Length of the sixth instar larva ranges from 20 to 46 mm.

Larval Variations: A variety of color phases occur ranging from almost pure creamy white to black with yellow subdorsal stripes. The dark phase is most common and is marked laterally with pale supra and sub-spiracular lines and dark spiracular lines in addition to the yellow subdorsal lines. Paler specimens of the dark phase

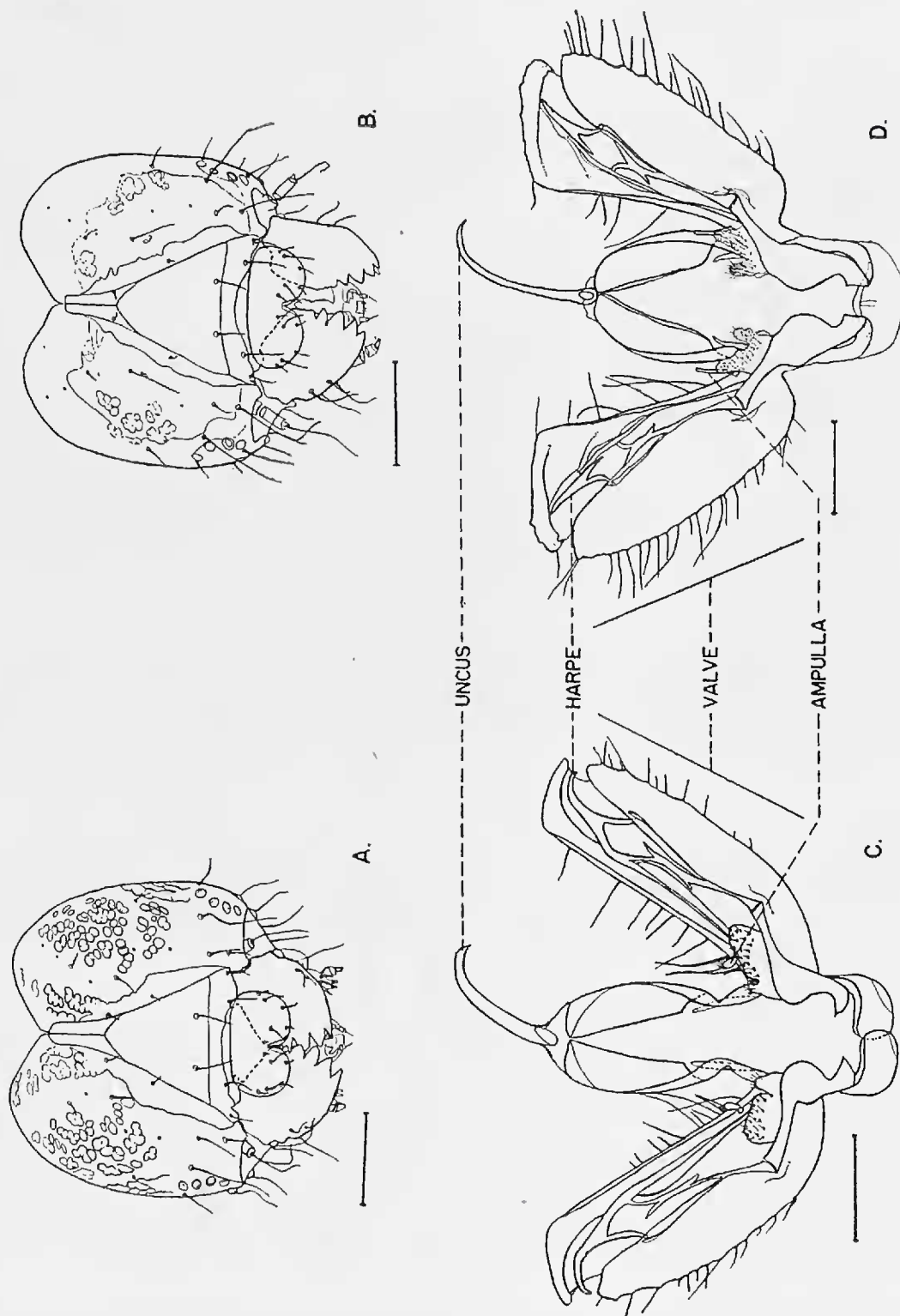


Fig. 1.—A) *Prodenia praefica* Grote, head capsule mature larva; B) *P. ornithogalli* Guenée, head capsule mature larva; C) *P. praefica* Grote, male clasper; D) *P. ornithogalli* Guenée, male clasper. [Lines at lower left in each figure represent 1 mm.]

frequently bear series of triangular black marks medial to the yellow subdorsal lines. Dark lateral markings on the thoracic segments are also sometimes conspicuous along with more or less characteristic round dark spots in the spiracular line on each side of the first abdominal segment.

Location of Type: British Museum of Natural History.

Type Locality: Mendocino City, California.

PRODENIA ORNITHOGALLI Guenée

Prodenia ornithogalli Guenée, 1852, Sp. Gen. Lep. Noct., 1:163; Walker, 1856, Cat. Lep. Het. Br. Mus., 9:193; Riley, 1882, Papilio 2(3):43; 1882 Check List Macrolepid. of Amer. N. of Mex., Brookl. Ent. Soc., pg. 14; Smith, 1893, U. S. Nat. Mus. Bull. 44:169-170; Dyar, 1902, U. S. Nat. Mus. Bull. 52:123; Beutenmueller, 1902, Amer. Mus. Nat. Hist. Bull. vol. 16, art. 33:422-423; Hampson, 1909, Cat. Lep. Phal. Br. Mus. 8:242, 248-250 pl. 128 fig. 19; Woodworth, 1911, Calif. St. Comm. Hort. Mon. Bull. 1(10):788; Barnes and McDunnough, 1917, Check List of Lepid. of Bor. Amer., pg. 67; Seitz, 1923, Macrolepid. World div. 2 vol. 7:256, pl. 37D; Crumb, 1927, Bull. Brookl. Ent. Soc. 22(1):43, 51-52, pl. 4B and 5D; Crumb, 1929, U.S.D.A. Tech. Bull. 88:149-156 (illustrated); Whalen, 1930, Penn. St. Agr. Expt. Sta. Bull. 335:80; McDunnough, 1938, Mem. S. Calif. Acad. Sci. 1(1):96; McDunnough, 1943, Canad. Ent. 75(1):1.

Prodenia ornithogalli eudiopta, Dyar, 1902, U. S. Nat. Mus. Bull. 52:123.

Prodenia eudiopta Guenée, 1852, Sp. Gen. Lep. Noct. 1:164; Walker, 1856, Cat. Lep. Het. Br. Mus. 9:193; Beutenmueller, 1902, Amer. Mus. Nat. Hist. Bull. Vol. 16, art. 33:423-424; Smith, 1893, U. S. Nat. Mus. Bull. 44:170; Chittenden, 1901, U.S.D.A. Div. Ent. Bull. 27 (rev. ed.) :64, 75, 114; Tietz, 1936, Penn. St. Agr. Expt. Sta. Bull. 335:80.

Prodenia flavimedia Harvey, 1874, Bull. Buff. Soc. Nat. Sci. 2:274; 1882, Check List Macrolepid. of Amer. N. of Mex., Brookl. Ent. Soc., pg. 14.

Prodenia lineatella Harvey, 1874, Bull. Buff. Soc. Nat. Sci. 2:275; French, 1881, Canad. Ent. 13:24; Grote, 1881, Papilio. 1(8):128; 1882, Check List Macrolepid. of Amer. N. of Mex., Brookl. Ent. Soc. pg. 14.

Prodenia commelinae Riley, 1871, 3rd rept. Ins. Mo. :113, fig. 48b (1871); Grote, 1875, check list Noct. :11.

Prodenia praefica form *eudioptoides* Barnes and Benjamin, 1923, Contr. Nat. Hist. Lep. N. Amer. 5(2):81; Seitz, 1923, Macrolepid. World div. 2 vol. 7:256, pl. 37E.

Female: Similar to *praefica* but somewhat less somber; the apical fascia and white markings of forewing usually more distinct. Secondaries clothed with tiny scales giving them a semi-hyaline and somewhat violaceous appearance, infuscation only in costal region and along outer margin. Veins brownish, discal spot wanting.

Male: Pale bodied, forewings rather brightly colored, with strongly produced apical fasciae; area posterior to the reniform stigma in some specimens orange brown. The outer costal margin and inner margin rufous,

costal area of ventral surface also rufous; secondaries similar to those of female but with less extensive infuscation at apical angle. Abdomen ochreous white, venter speckled with rufous.

Larva: Similar to that of *praefica* but with greatly reduced reticulation on head capsule.

Type Locality: Central America.

Location of Type: Unknown.

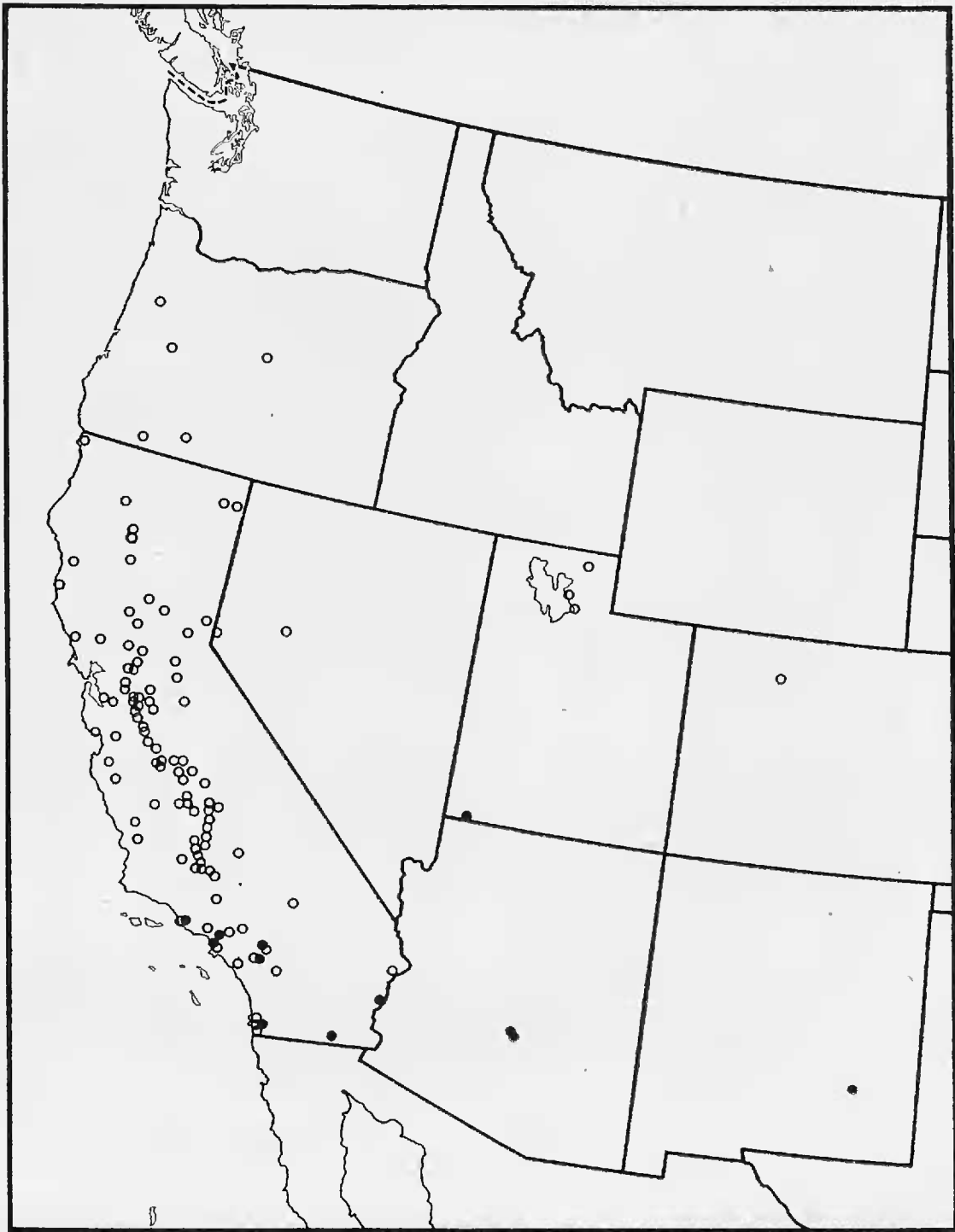


Fig. 2. Distribution of *Prodenia praefica* Grote (open circles) and *Prodenia ornithogalli* Guenée (solid circles) in the western United States.

GEOGRAPHICAL DISTRIBUTION

Prodenia praefica and *P. ornithogalli* differ greatly in distribution with the latter having much the wider range. *P. ornithogalli* occurs in South and Central America, Mexico, and the islands of the Carribean as well as the United States. In the United States it occurs abundantly in the Southeast and has been encountered as far north as Minnesota and Massachusetts and as far west as California, but not in the Northwest (See fig. 2.).

The range of *P. praefica* is apparently limited to western North America. It has been recorded as far north as central Oregon and Montana, as far south as San Diego on the southern border of California, and as far east as Colorado. No records are available which indicate that it occurs in the southwestern states but it possibly exists in low abundance in the northwestern part of Arizona.

Because of the confusion which has existed in the literature as to the distribution of these species in the West, and because of the significance of this in the interpretation of the relationships of the two forms, intensive studies were conducted during 1948 and 1949 in California to determine as precisely as possible the distribution of *P. praefica* and *P. ornithogalli* within the state. These studies were carried out by means of several sampling devices and methods. The most useful was a monochromatic electrocutor type light trap using a pale blue spiral gas discharge tube (predominant wave length about 4320°A) as the attractant. New Jersey mosquito traps with white Mazda type light were also used. In addition to light traps, bait pan traps employing a yeast-diamalt fermenting lure produced valuable records from western Stanislaus County. Larval sweepings from various cultivated and non-cultivated host plants at a number of localities also added to the distributional records.

In 1948 seven monochromatic traps were operated throughout the state and in 1949 ten traps were run. Certain lights were operated at the same localities during both years, while others were shifted to different places the second year. In this way comparative records for the two years were obtained from several localities while the remaining lights were used to determine the status of the two species at a variety of places.

In 1948 traps were operated at Berkeley, San Antonio Valley (Santa Clara County), Patterson (Stanislaus County), Dos Palos (Merced County), and Shafter (Kern County) in northern and

central California and captured a total of 5990 *Prodenia* adults. During the same period twenty-two bait pan traps located at Patterson captured 3030 additional specimens of *Prodenia*. The aggregate of 9020 moths collected north of the Tehachapi mountains during 1948 was entirely of *P. praeifica*.

During the same year two monochromatic traps were operated in southern California, one at Corona and the other at El Centro. The latter functioned for only eleven days and captured no *Prodenia*. The Corona trap, however, was operated from April 1 to December 11 and produced twenty-three *Prodenia*. This was a mixed catch, consisting of ten *P. praeifica* and thirteen *P. ornithogalli*.

In 1949 monochromatic light traps were again operated at Patterson and Shafter in northern California, but they were discontinued at Berkeley, San Antonio Valley, and Dos Palos. However, two of these traps were transferred to new localities, one at Ryer Island (Solano County) and the other at Gilroy (San Benito County). The four traps produced a total of 30,381 *P. praeifica*. Twelve bait pans, again located in the Patterson area, captured 6395 *Prodenia* also all *praeifica*. Thus, as was the case in 1948, the entire *Prodenia* catch from monochromatic light traps and bait pans, located north of Tehachapi mountains, was composed of *P. praeifica*. In 1949 light trapping was expanded in southern California with a total of six monochromatic traps being used. These lights were located at Corona (Riverside County), Hemet (Riverside County), Port Hueneme (Ventura County), Bostonia (San Diego County), Meloland (Imperial County), and Blythe (Riverside County). As was the case in 1948, the catch was mixed consisting of fifty-three *P. praeifica* and twenty-three *P. ornithogalli*.

SEASONAL DISTRIBUTION

Records obtained from the sampling devices used in the geographical distribution studies discussed above also supplied valuable information concerning the seasonal distribution of *P. praeifica* and *P. ornithogalli*. Data obtained at Corona in 1948 indicate that the two species differ greatly in seasonal distribution. Operation of the Corona trap was not initiated until the first of April of 1948 and no data are available to compare the early season activity of the two species, but the trap was operated through the middle of December of that year and the record shows that

P. ornithogalli was active much later in the year than *P. praeifica*. With *ornithogalli* six of the thirteen specimens trapped were taken after October 1, the last moth being captured on December 2, while with *P. praeifica* no specimen was captured after September 11. Although this record of seasonal occurrence of the two species in southern California might seem scanty when based on such a small sample, it is strongly bolstered by the records from northern and central California which showed that practically no *P. praeifica* moths were extant there after September 30. Furthermore, collection of *P. ornithogalli* larvae from an alfalfa field at Riverside on November 5, 1952, and from alfalfa on November 12, 1953, in Blythe, and on December 2, 1953 at San Diego, gives additional evidence of the late season activity of this species. The probable reason for the early cessation of activity by *P. praeifica* will be discussed below.

DISCUSSION

The intensive trapping activities conducted during 1948 and 1949, augmented by miscellaneous records, show that *Prodenia praeifica* is widely distributed over the state of California (Fig. 2) while the closely allied *P. ornithogalli* is restricted to the area south of the Tehachapi mountains where the two species overlap in distribution, but maintain their identities. *P. praeifica* occurs in great abundance in the area north of the Tehachapi mountains (particularly the Central Valley) while neither species is abundant in southern California.

The difference in the seasonal distribution of the two species probably results from differences in their overwintering habits. *P. praeifica* is a temperate area species being native to western North America. It passes the relatively severe winters of its native habitat in a pupal diapause which commences in September following the fourth larval brood and lasts until the following January or February. This diapause appears to affect essentially all fourth brood specimens so that there are practically no moths extant after the end of September. *P. ornithogalli*, on the other hand, being a tropical species apparently has no true winter diapause and thus occurs in its various stages until the time of killing frosts. It most likely survives the winter in largest numbers in the pupal stage in the soil, but individuals may possibly pass the winter as larvae or adults in milder localities or in protected places.